

What is Life?

Motivation

There are strong reasons to believe that life first appeared on Earth about 3.8 billion years ago. The evidence is partly in the form of fossils found in ancient rock strata and partly in the form of chemical evidence for the existence of life forms. The interpretation of some of this evidence is a bit controversial and, as a result, it is not completely clear just when the earliest life signs arose. Some chemical indicators which suggest a first appearance as much as 3.85 Ga (3.85 billion years ago). Fossil remnants of blue-green alga colonies (stromatolites) date to 3.5 Ga. (The controversial aspects mainly have to do with identifying structures in the rock as fossils, whether the chemical evidences are really the product of life processes, and the age dating methods employed.)

Some have suggested that life might have arisen elsewhere (exogenesis) and been transported to the young Earth *via* comets, meteoroids, or interstellar dust. Whether life can or cannot be successfully transported between astronomical bodies (panspermia), the possibility of life flourishing on other planets, including planets circling other stars, or in other non-terrestrial environments, has motivated considerable speculation, study, and search attempts. However, any investigation of the origins of life, or a search for life elsewhere in the universe, must begin with a definition of life itself.

Please provide answers to the three question below. (Due November 17)

- What is life? (Please provide a *useful* working definition.)

Can one define life by its behavior? (*e.g.*, Does your definition require reproduction?)

Can life be defined by its chemical constituents? (*e.g.*, Must it be hydrocarbon based?)

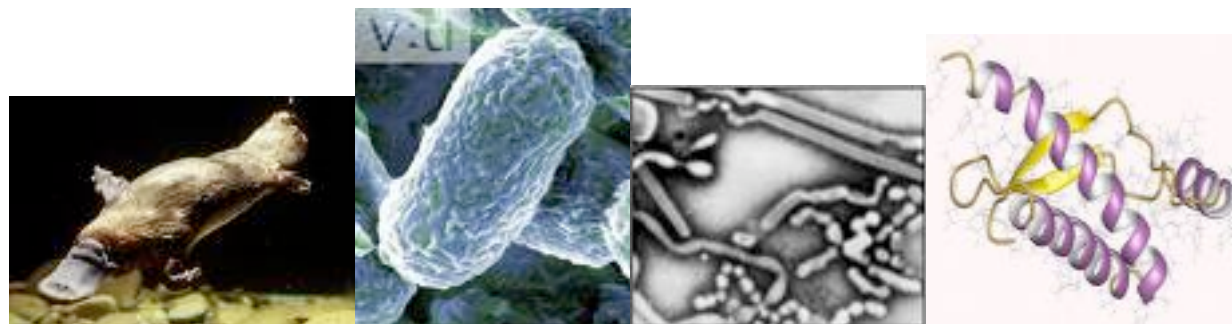
Which of the characteristics must always be present if life is present? Which are optional?

Which of these characteristics are occasionally exhibited by non-life? (*e.g.*, Is crystal growth considered to be “reproduction”?)

- How would you recognize life if you encountered it?

In particular, is it really possible to infer the presence - or prior presence - of life through its remnants (chemical or physical tracks, fossils,...) or other effects upon its environment?

- Given your definition of life, how would you characterize each of the following; living or nonliving? Please explain your choices: (1) a platypus, ((2) a fungus,(3) an amoeba, (4) an *e coli* bacterium, (5) a cold virus, (6) a BSE prion, (7) a chlorophyll molecule, (8) a protein, (9) a methane molecule, (10) a quartz crystal



Since the time of Aristotle there have been many definitions of life, most involving several requirements. Feel free to pick and choose among them. Just justify your choices and, as always, cite your sources.